Landsat Update - Volume 1, Issue 4, 2007

Landsat Science Team Spotlight

Prasad S. Thenkabail
International Water Management Institute (IWMI)
Colombo, Sri Lanka

Prasad S. Thenkabail, an American National, has 23 years' experience working as an international expert in Remote Sensing and Geographic Information Systems (RS/GIS) and its applications to natural resources management, sustainable development, and environmental studies. He has visited and worked in over 25 countries in Africa, Asia, the Middle East, and North America.

During the last 4 years, Thenkabail has worked for IWMI as a principal researcher of the Global Research Division. Currently, he is the head of the RS/GIS & Natural Resource Management Group. In this position he works globally, mostly in economically developing countries, providing leadership for various projects and in spatial data applications for thematic research. Projects he has led include global irrigated area mapping (GIAM), droughts (remote sensing component), wetland mapping, knowledge base systems for Sri Lanka (KBS-Lanka), and water productivity studies. All of the projects involve heavy use of spatial datasets, especially satellite sensor data. Thenkabail has led the development and launch of the following Web portals: IWMI Data Storehouse Pathway (http://www.iwmidsp.org), Global Irrigated Area Mapping (http://www.iwmigiam.org), and KBS-Lanka (http://www.iwmikbs.org). He has contributed significantly to the IWMI Drought Monitoring System (http://dms.iwmi.org) and Tsunami Satellite sensor Data Catalogue (http://tsdc.iwmi.org).

Thenkabail is an editor for the Remote Sensing of Environment journal. He is also one of the associate editors-in-chief of the Journal of Spatial Hydrology (JoSH). In June 2007, Thenkabail's team was recognized by the Environmental Systems Research Institute (ESRI) for "Special Achievement in GIS" (SAG award) for their Tsunami-related work and for their innovative spatial data portal (http://www.iwmidsp.org) and science applications (http://www.iwmigiam.org).

Did you know...

Can you determine which spectral bands would be best to use?

This question is asked by all users of remotely sensed data. The level of detail (spatial resolution) is often the most considered aspect of using a satellite image. Less appreciated is how land surfaces reflect irradiative energy differently and how to use this information to identify features of interest.

Scientists at the U.S. Geolocial Survey (USGS) Center for Earth Resources Observation and Science (EROS) developed an interactive tool that helps visualize how the bands on different satellite sensors measure the intensity (relative spectral response -RSR) of wavelengths (colors) of light By overlaying the spectral curves from different features (spectra), you can determine which bands of the selected sensor will work for your application.

Check out the Spectral Characteristics Viewer! http://ldcm.usgs.gov/viewer.php

Shoemaker Awards for External Communications

The Shoemaker Awards for External Communications recognize USGS products that demonstrate extraordinary effectiveness in communicating and translating complex scientific concepts and discoveries into words and pictures that capture the interest and imagination of the American public. The judges are communicators, designers, and scientists from the public and private sector.

This year USGS and SAIC employees located at EROS were recipients of this prestigious award for their work on the EarthNow! Landsat Image Viewer (http://earthnow.usgs.gov) and the Smithsonian Institution's Earth from Space traveling exhibit (http://www.earthfromspace.si.edu/).

How fast do Landsat users need their data?

More results from the USGS non-Federal customer satisfaction survey

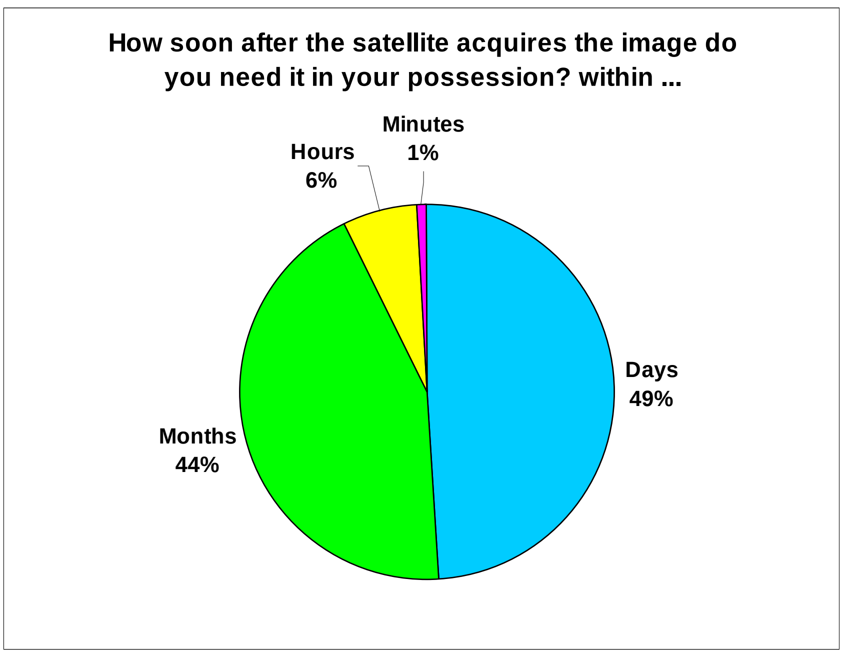
The article on the "Landsat Non-Federal Customer Satisfaction Survey" in the last issue focused on users' satisfaction with the accuracy of Landsat data. In that same survey, we also asked users how quickly they need the data, how satisfied they are with delivery times, and what are the impacts if the data are not received in the time frame they require.

We asked data users about two different time factors of concern to Landsat Data Continuity Mission (LDCM) mission planners:

1. How soon after the satellite acquires the image do you need it in your possession?
2. How soon after you place the order do you need it in your possession?

For both questions, no preset values were given—we allowed users to write in a value and indicate the units (minutes, hours, days, or months). Most users did not write in a number, but they did select the unit of time, which gives a general indication of how quickly they need the image/data.

The response to the first question is shown in the chart below. Of the 225 non-Federal users who responded to this question, 93 percent indicated they need the data within days or months after the satellite acquires the data. Only 6 percent of the users indicated they need it within hours, and 1 percent requested data within minutes.



Another timeline of concern—once users have ordered the data, how quickly do they expect delivery? The respondents' answer to this question is shown in the chart below. A similar color scheme is used to compare customer expectations for the two timelines.

From these two charts, the following points are evident:

▪ It appears that, for most of these users, it is acceptable to take days (48 hours or more) after image acquisition to process the data and make it available for ordering.

▪ Users expect a more rapid response to their requests; however, it is still acceptable to most of these users to take days (over 24 hours) to fulfill an order request.

▪ A small percentage of users need the data quickly after acquisition, and failure to meet that need can have a big impact. We asked survey respondents, "What is the impact if the data does not arrive within your required time?" Some of the more time-sensitive responses we received were:

o "After a hurricane [I would] have problems, in other time[s] [it] is not much [of a] problem"

o "Because I work with irrigation areas [it] is very important to obtain the images as soon as possible. This [is] in order to provide support in farm management in near real time."

o "…based on a TM image taken on a Monday, we may make decisions regarding recreation, livestock grazing, fire threats, etc., on a Wednesday afternoon 2 days later. So time would be critical in that instance."

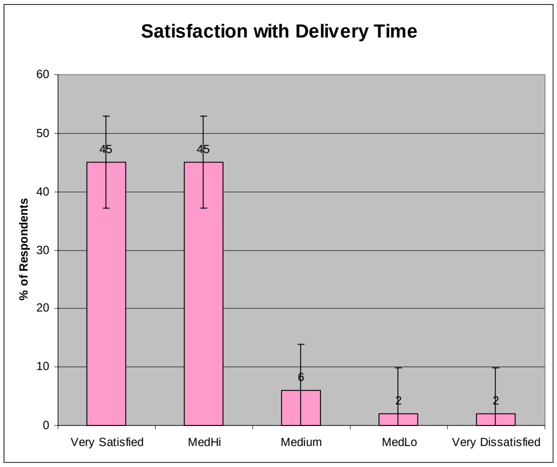
o "For my primary project, delivery impacts time for analysis and timely dissemination of results that have potential economic and legal ramifications."

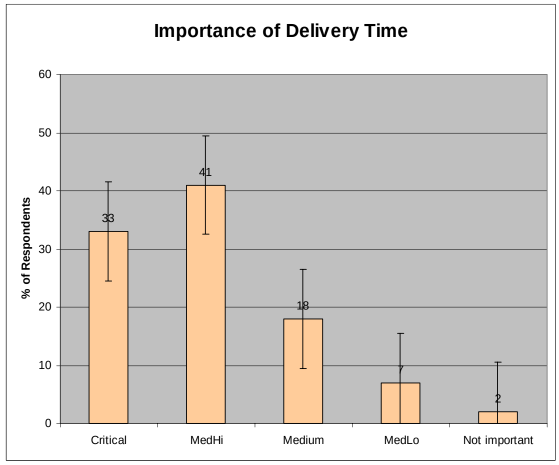
o "We are also experimenting with using Landsat in part of rapid federal assessments of forest damage due to catastrophic storms. This type of application requires imagery within about a day of acquisition."

We also asked users to rate their satisfaction and the importance of current Landsat data delivery times on a scale of 1 to 5, where 1 is high and 5 is low. Results are shown in the charts below.

▪ The mean satisfaction rating was 1.69, with a standard deviation of 0.8.

▪ The mean importance rating was 2.08, with a standard deviation of 0.97.





While users appear to be satisfied with current data delivery times, the mean importance rating seems to be larger than the satisfaction rating. From many of the comments users gave when asked about the impact of delivery times, it appears that users would certainly benefit from and appreciate faster turnaround times from image collection through data processing, production request, and delivery. We also need to take into account the more time-critical applications of the data, such as disaster response and operational land management.

What is USGS doing to improve delivery times?

The Landsat Data Continuity Mission (LDCM) is formulating requirements for a system that will process and make LDCM data available for users to download within 24 hours of acquisition. This system will improve upon the delivery time users experience today and support time-critical applications in a more automated way.

In the meantime, efforts are under way at USGS EROS to make all newly acquired Landsat 7 cloud-free data available within 12 hours of reception.

Tambora, Sumbawa, Indonesia

Article reference from online source: VolcanoWorld
http://volcano.und.edu/vwdocs/volc_images/southeast_asia/indonesia/tambora.html

Location: 8.3S, 118.0E; **Path** 115, **Row** 66
Elevation: 9,348 feet (2,850 m)

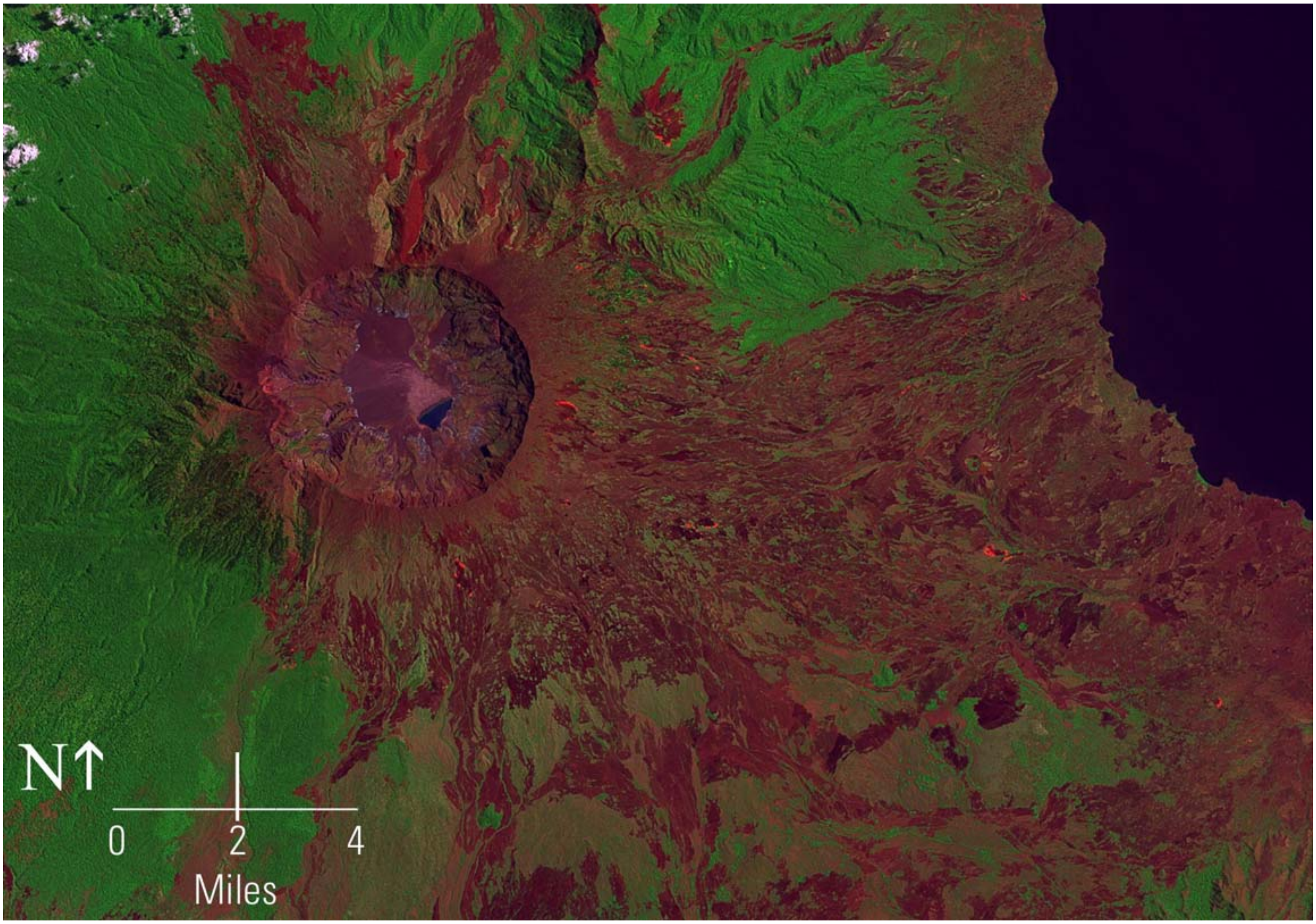


fig. 1. Mt. Tambora. Landsat 7 SLC-on; September 13, 2000

Mount Tambora (or **Tomboro**) is an active strata volcano on Sumbawa Island, Indonesia. Sumbawa Island is part of the Lesser Sunda Islands, which is a segment of the Sunda Arc, a string of volcanic islands that form the southern chain of the Indonesian archipelago.

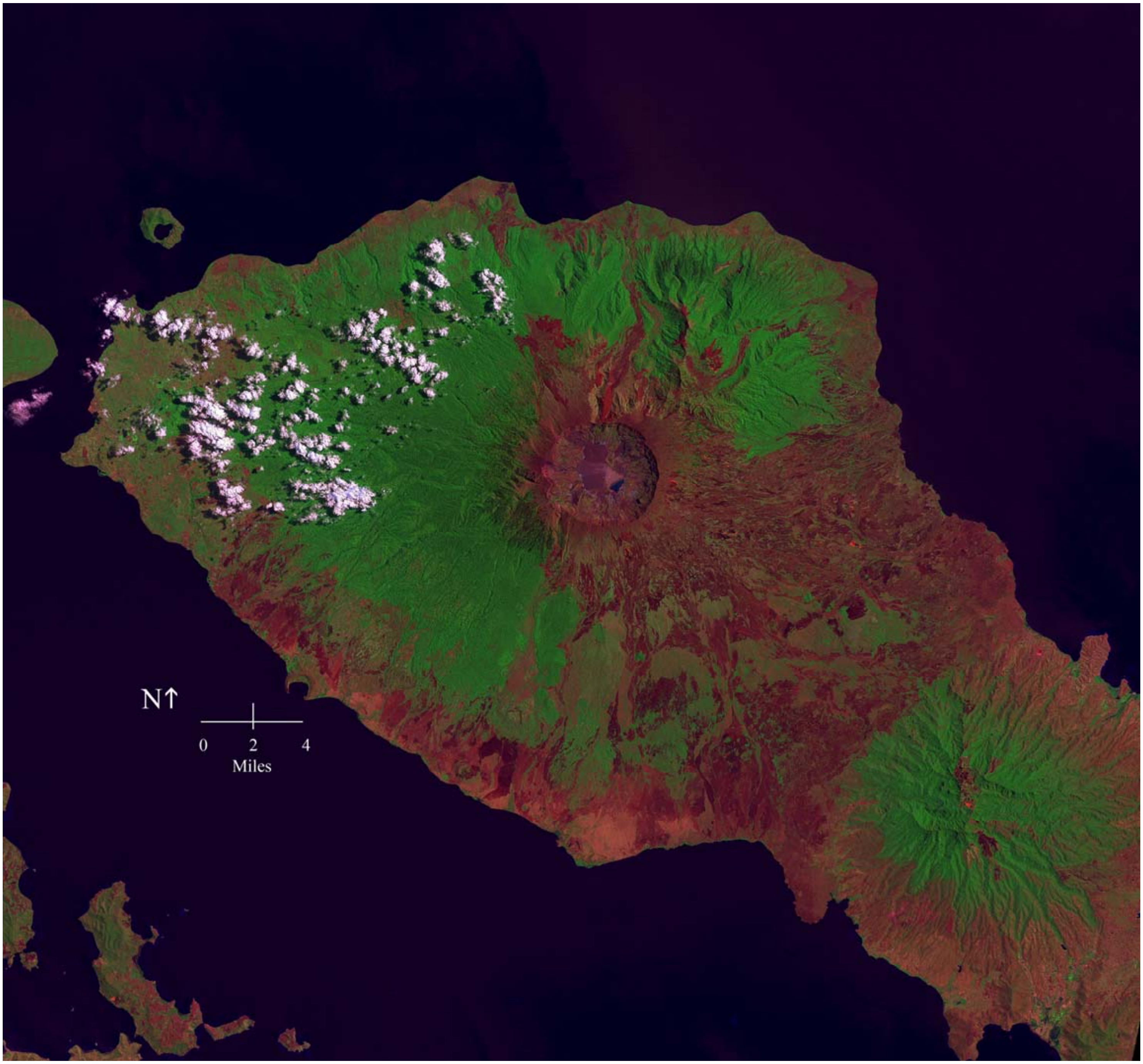


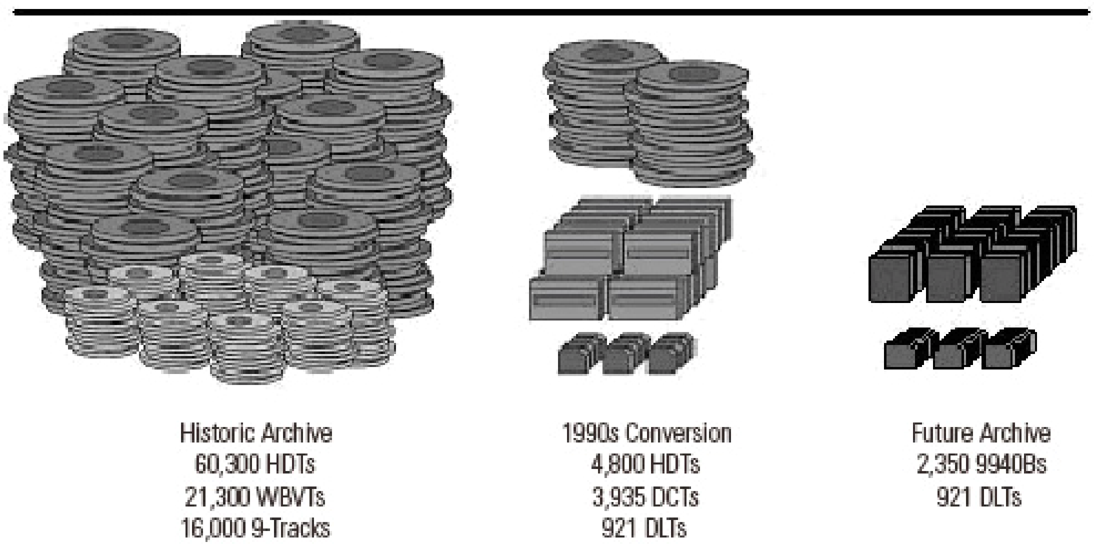
fig. 2. Sanggar Peninsula. Landsat 7 SLC-on; September 13, 2000

Tambora erupted in 1815 with a rating of seven on the Volcanic Explosivity Index. The explosion was heard on Sumatra Island more than 2,000 km (1,200 mi) away. Heavy volcanic ash falls were observed as far away as Borneo, Sulawesi, Java, and the Maluku islands.

The death toll was at least 71,000 people, of which 11,000–12,000 were killed directly by the eruption. The eruption created global climate anomalies; 1816 became known as the “Year without a Summer” because of the effect on North American and European weather. Agricultural crops failed and livestock died in much of the Northern Hemisphere, resulting in the worst famine of the 19th century.

The Evolution of Digital Data Technology

Throughout the years, advances in technology have created opportunities for archives to store more data, while taking less space and resources.



At EROS, the archive began with film…rolls and rolls of film. When the digital revolution hit EROS in 1974, we were at the forefront of technology, using a 9-track tape called the 3420 (fig. 3). The 3420 had a capacity of 150 MB of data, or about half of one Landsat Thematic Mapper (TM) scene. This remarkable piece of technology was in use for 14 years until data was transferred to more updated storage units.

fig. 3. 3420 9-track tape

The progression from reel tapes to a pure digital format is an ongoing process. As new technology becomes available, EROS must meet the demands of storing ever-increasing bits of newly acquired data. At the same time, it is vital that the data stored on older forms of equipment get transferred to whatever new technology is being used at the time. Another challenge is to be certain that we retain equipment that can read the older media and successfully interface with the new technology.

Type	Capacity	Capacity (in scenes)	In Use:
1) 3480 Cartridge Tape	300 MB	1 TM Scene	5/1/1990 – Present
2) 3490 Cartridge Tape	800 MB	2.5 TM Scenes	1/20/1985 – Present
3) Digital Linear Tape	35 GB	116 TM Scenes	1/31/1996 – Present
4) High Density Tape	2 GB	6 TM Scenes	11/1/1965 – 11/3/1996
5) Digital Cassette Tape	48 GB	160 TM Scenes	3/13/1991 – Present
6) T9940 Cartridge Tape	200 GB	6650 TM Scenes	3/01/2004 – Present
7) Compact Disk	650 MB	2 TM Scenes	7/13/1992 – Present
8) Linear Tape-Open (LTO)	400/200 MB Compressed/Uncompressed	12,000/6,000 TM Scenes	6/01/2003 – Present
9) 8mm Tape	5.06/2.5 GB High/Low Density	16/8 TM Scenes	6/01/1990 – Present

1)

2)

3)

4)

5)


6)


7)


8)


9)

Conference Information

Conferences Attended

The 2007 IEEE International Geoscience and Remote Sensing Symposium: July 23–27, 2007

32nd International Symposium on Remote Sensing of Environment: June 25–29, 2007

Society of American Foresters National Convention: October 23–27, 2007

American Society for Photogrammetry & Remote Sensing (ASPRS)
& the Canadian Remote Sensing Society (CRSS): October 28–November 1, 2007

Geological Society of America (GSA): October 28–31, 2007

Conferences Scheduled to Attend this Calendar Year

American Geophysical Union
December 10–14, 2007
San Francisco, CA
In support of the USGS exhibit.

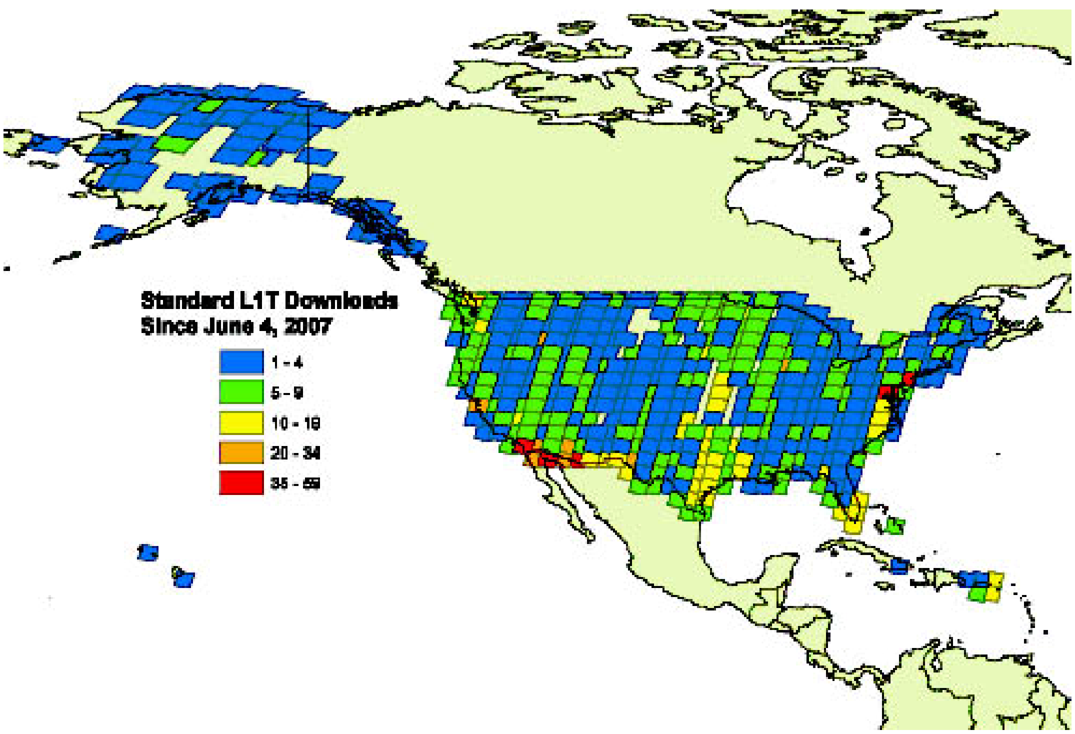
Landsat Updates - Volume 1, Issue 3, 2007

Web-enabled Landsat Data

June 4, 2007, marked the first day of the distribution of Web-enabled Landsat 7 ETM+ data. More than 2,500 scenes were distributed the first month, equivalent to three months of normal data sales. This Web-enabled distribution of new and recently acquired data is a pilot project for the Landsat Data Continuity Mission (LDCM). The project will allow the Landsat data user community to help refine the distribution system planned for the upcoming LDCM, currently projected for launch in 2011. Each scene will be registered to the terrain, or “orthorectified,” prior to being placed on the Web. Copies of these data will also be available on CD or DVD for the cost of reproduction.

Landsat data have proven useful for a wide range of applications. From disaster monitoring after Hurricane Katrina and the Indonesian tsunami to global crop condition analysis, Landsat data are being used by scientists around the world. The Web-based distribution system will allow the user community easier access to Landsat 7 data.
The pilot project will be carefully examined. Customer response will be evaluated and their insight will influence the future distribution system. Please contribute feedback via the Web at http://landsat.usgs.gov/links/contact.php or contact USGS Center for EROS Customer Service at 800-252-4547.

The map below displays the number of scenes downloaded for each path/row available. Areas outside the United States are not included in the data set.



Landsat Science Team Spotlight

To address the science goals of the Landsat Data Continuity Mission (LDCM), the Landsat Science Team has been selected to investigate and advise the U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA) on issues critical to the success of this endeavor. With that in mind, we would like to take the opportunity for you to get to know Dennis Helder.

Dennis Helder
Image Processing Laboratory – South Dakota State University (SDSU)

Degrees:

Ph.D. in EE, North Dakota State University, 1991
Dissertation Title: Debanding Thematic Mapper Imagery
M.S. in EE, South Dakota State University, 1985
B.S. in EE, South Dakota State University, 1980
B.S. in Animal Science, South Dakota State University, 1979

Primary Focus:

The research work mainly focuses on satellite radiometry of Landsat 4, 5 and 7. Radiometric calibration of satellites involves characterization and correction of systematic degradations affecting the imagery. These degradations are caused by instrumentation and the Earth's atmosphere. Our work allows users to extract more information from remotely sensed data. Currently, we are working on ALIAS (Advanced Land Image Assessment System) and TMIAS (Thematic Mapper Image Assessment System) developments.

Current Projects by Dr. Helder and His Staff:

http://iplab2out.sdstate.edu/

- ALIAS development
- Radiometric Characterization and Calibration of Landsat 4/5 Thematic Mappers
- Landsat 7 DARK/PAC/FAC Coherent Noise Characterization
- Landsat 7 Night Scene (row 179-191) Coherent Noise Characterization
- Field Campaigns
- IKONOS and QuickBird Modulation Transfer Function (MTF) Measurement Project

Publications:

http://iplab2out.sdstate.edu/

How well does Landsat accuracy meet users' needs?

The article on the Landsat nonfederal customer satisfaction survey in the last issue focused on cost as a barrier to data usage. Next we will present a series of follow-on articles to explore some of the other topics covered in the survey.

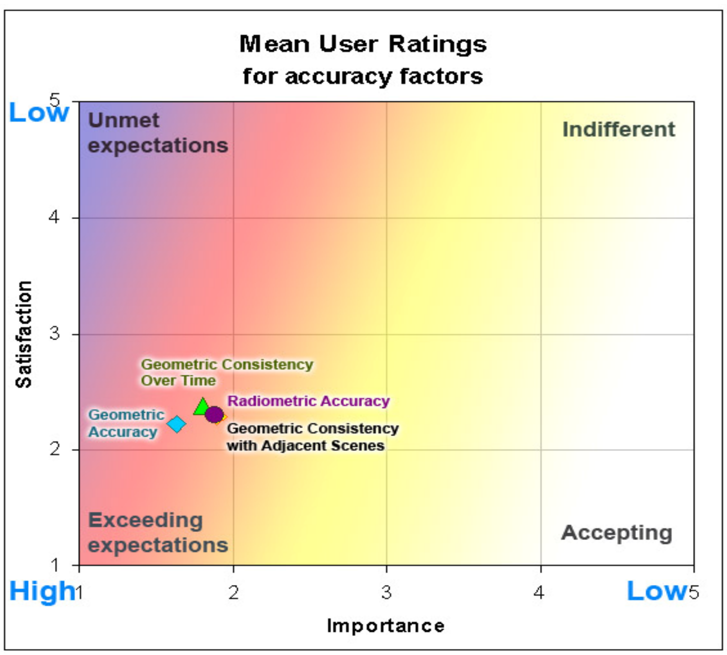
In this issue we are focusing on accuracy.

In the recent nonfederal survey, we asked several questions about accuracy:

- What is your level of satisfaction and importance with
    - geometric accuracy and consistency.
    - radiometric accuracy.
- What is the level of importance of radiometric consistency
    - within a scene.
    - with adjacent scenes.
    - over time.
- What level of geometric accuracy do you require?

For satisfaction and importance, we asked users to rate their satisfaction from 1 to 5, where 1 is high and 5 is low. Similarly, we asked respondents to rate the importance of each of the factors.

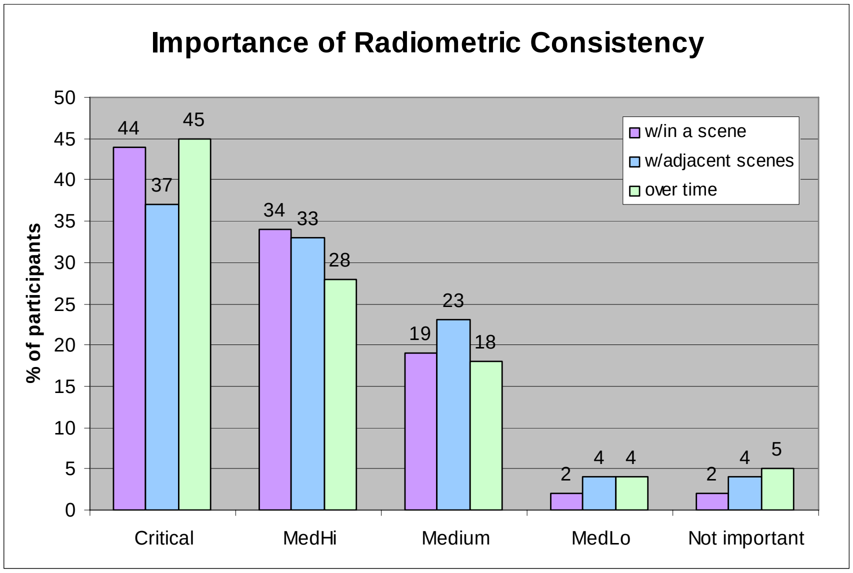
Mean ratings of satisfaction and importance with accuracy and consistency factors are shown in the scatter plot below. (Geometric consistency with adjacent scenes falls behind the radiometric accuracy point.) The users' surveyed rate geometric and radiometric factors highly important, but they are not entirely satisfied with the current levels of accuracy. Their responses indicate that the users would like to see some improvements in these areas.



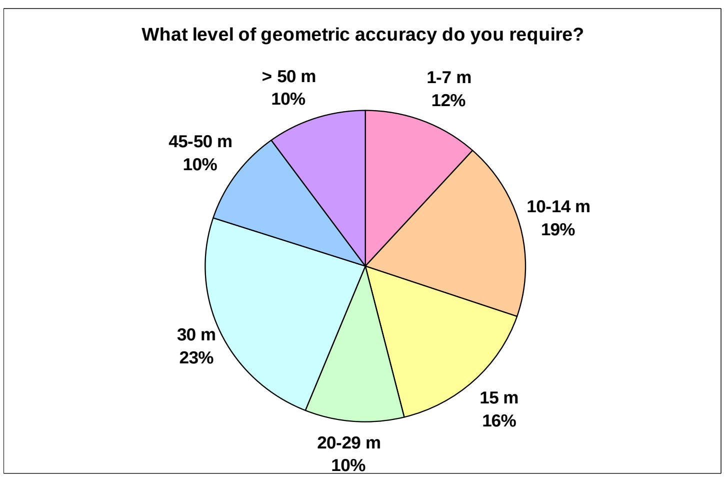
A similar scale (from 1 to 5 where 1 is critical and 5 is not important) was used to rate radiometric consistency. Results are shown in the bar graph below. Grouping the critical and medium-high responses as "important" and the rest as "not important" indicates:

- 78% of respondents think radiometric consistency **within a scene** is important.

- 73% of respondents believe radiometric consistency **over a time series of scenes** is important.
- 70% of respondents indicate radiometric consistency **with adjacent scenes** is important.



The geometric accuracy information was collected as a freeform text entry field where users entered a number indicating required accuracy in meters. Responses are grouped and shown in the pie graph below. Adding up the responses, 80 percent of users indicate that they need geometric accuracy of 30 m or higher (for recently acquired Landsat data, this translates to "within a pixel").



What is USGS doing to improve accuracy?

Radiometric accuracy and consistency

The Landsat Project continues to monitor and characterize the radiometric and geometric performance of the Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) instruments in order to update and apply calibration parameters using the best information available. These efforts will further enable cross-calibration and integration of TM and ETM+ data for monitoring land surface change and coastal processes. Characterization and calibration of historic satellite data from Landsat 4 TM is underway, in addition to a feasibility assessment for Multi-Spectral Scanner (MSS) data, which encompasses 23 years of the Landsat archive.

The Operational Land Imager (OLI) on LDCM is being designed to achieve improved radiometric performance. For example, measurements will be quantized to 12-bit resolution, rather than the 8-bit quantization for TM and ETM+, so there will be no need for high or low gain data collection modes. The relative spectral response functions of the OLI spectral bands have improved specifications to increase signal-to-noise performance. In addition, LDCM OLI data will be cross-calibrated, to the extent practicable, with Landsat ETM+ data to assure consistency and continuity of use.

Geometric accuracy and consistency

The Landsat Project has released Level 1T (L1T) products for the conterminous United States, Alaska, Hawaii, and U.S. Territories for Web-enabled access since June 4, 2007. These L1T products are generated using the most current radiometric calibration parameters, geodetically referenced using definitive ephemeris and ground control points, and terrain corrected using the National Elevation Dataset (NED) or GTOPO30 elevation data.

In the era of the Landsat Data Continuity Mission (LDCM), the standard data product made available via web-enabled access will also be L1T data, yet we anticipate the geodetic accuracy will be enhanced due to improvements in platform and instrument ephemeris information.

LDCM Announces OLI Instrument Developer

July 16 – Ball Aerospace and Technologies Corp. of Boulder, Colorado, was selected to develop the Operational Land Imager (OLI) for the Landsat Data Continuity Mission. The LDCM is the successor to Landsat 7 and is scheduled for launch in July 2011.

NASA's Goddard Space Flight Center, Greenbelt, Maryland, will manage the LDCM development in partnership with the U.S. Geological Survey. The USGS will be responsible for LDCM operations after launch and on-orbit checkout. For more information, visit the LDCM Web site (http://ldcm.nasa.gov/07-16-2007.html).

Landsat Science Team Meeting

The Landsat Science Team met June 12–14, 2007, at Oregon State University, Corvallis, Oregon. The meeting was hosted by team member Warren Cohen of the USDA Forest Service.

The meeting included three objectives: (1) review the status of key LDCM and Landsat program activities, (2) review and receive Landsat Science Team input on key LDCM ground systems requirements, and (3) activate the Landsat Science Team working groups.

The status reports included NASA and USGS LDCM development progress, Landsat 5 and 7 operations status, the Mid-Decadal Global Land Survey, Landsat Data Gap Study, and the Future of Land Imaging. In addition, Landsat Science Team members presented brief updates of ongoing scientific research related to the LDCM project.

The ground system requirements discussion involved a summary of the LDCM Ground System Concept Review (SCR) held at the USGS Center for EROS on February 21–22, 2007. Several policy and technical issues were identified in the SCR, and the dispositions of these issues were reviewed with the Team so members could provide comments and recommendations.

The Team also presented an overview of the Ground Systems Requirements Review (SRR) that will be held on August 28–29, 2007, at USGS EROS. The SRR will be conducted by an independent panel of experts and represents a major milestone for the mission.

A major focus of the meeting was to convene working groups to discuss operations (long-term acquisition plan), Landsat data policy, data products (processing levels, information content), and instrument engineering (calibration of the LDCM Operational Land Imager, consistent calibration across the historical Landsat archive).

Key conclusions included Landsat Science Team recommendations to accelerate and expand USGS Web-enabled Landsat data plans and to pursue the consolidation of global Landsat holdings into a central archive.

The full agenda and presentation materials can be viewed at http://ldcm.usgs.gov/meeting.php

The next meeting will be held at USGS EROS in January 2008.

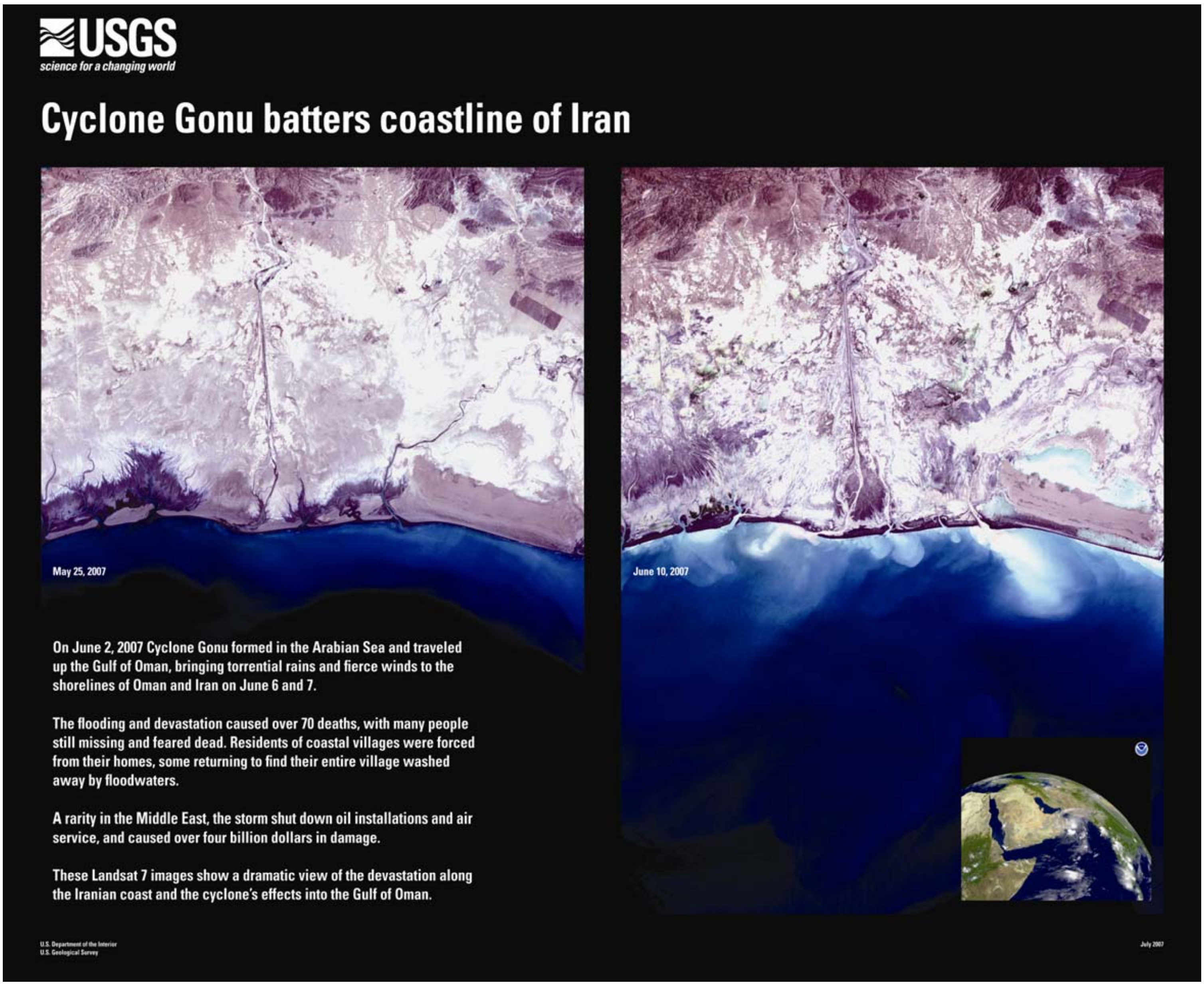
Cyclone Gonu

On June 2, 2007, Cyclone Gonu formed in the Arabian Sea and traveled up the Gulf of Oman, bringing torrential rains and fierce winds to the shorelines of Oman and Iran on June 6 and 7.

The flooding and devastation caused more than 70 deaths, with many people still missing and feared dead. Residents of coastal villages were forced from their homes, some returning to find their entire village washed away by floodwaters.

A rarity in the Middle East, the storm shut down oil installations and air service and caused more than/at least $4 billion in damage.

These Landsat 7 images show a dramatic view of the devastation along the Iranian coast and the cyclone's effects into the Gulf of Oman.



Did You Know?

You can export a listing of selected scenes from GloVis (USGS Global Visualization Viewer) to a text file format, as well as import a text file into GloVis?

Question:
I would like to use GloVis to develop a list of available Landsat scenes for a certain study area, but I want that list in a text file format. 1) Is there a way to export the list from GloVis to text? 2) I have another text file of Scene IDs—is it possible to import that list into GloVis?

Answer:
1. You can create a text file of all scenes you've added to the Scene List while searching on GloVis:
    a. Select scenes for your area of interest from each **Collections** and **Add** to the **Scene List** on each.
    b. When you have added all desired scenes, click **File → Save All Scene Lists**.
    c. Navigate to the destination where this file is to be saved.
    d. Name the file and click **Save.**

2. You can import an existing text file of Scene IDs into GloVis:
    a. In GloVis, select **File → Load Saved Scene List**.
    b. Navigate to the location of the file. When selected, the scenes are populated into the appropriate collection, and all footprints show on the GloVis map.

Example of Scene List:

```
sensor=Landsat ETM+
7029030000234750
7030029000311750
sensor=ASTER TIR
AST_L1A.003:2007291967
```

The first line indicates the file is a GloVis scene list file. The second line indicates the data set for the following scenes. After the second line, each line is interpreted as a Scene ID until the next "sensor=" line is found. The data set name for a "sensor=" line is the same name that shows up in the collection menu of the GloVis application.
**Follow this format correctly when loading scene lists into GloVis.*

Landsat Information

The maps below show the locations of ground stations operated by our International Cooperators (ICs) for the direct downlink and distribution of Landsat 7 (L7) and/or Landsat 5 (L5) image data. The red circles show the approximate area over which each station has the capability for direct reception of Landsat data. The green circles show the components of the U.S. Geological Survey (USGS) ground station network, while the dashed circles show stations with dual status.

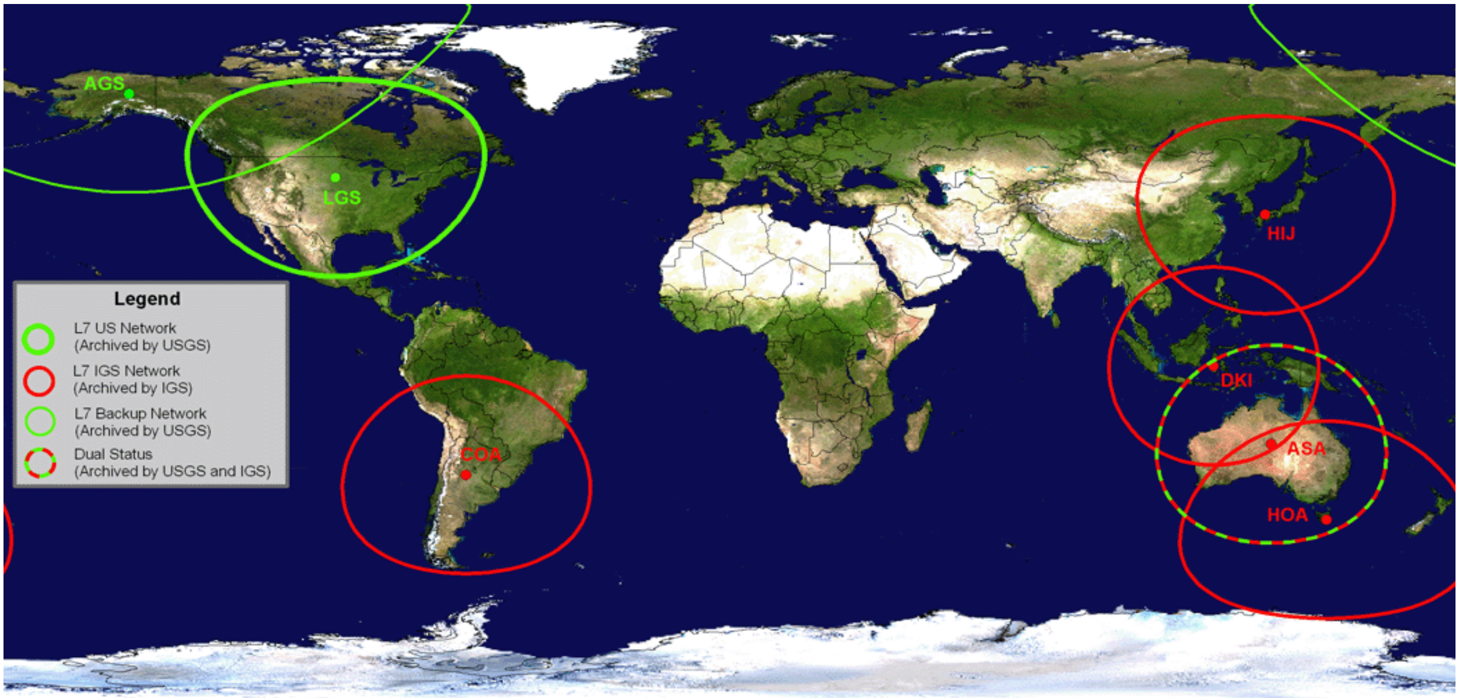
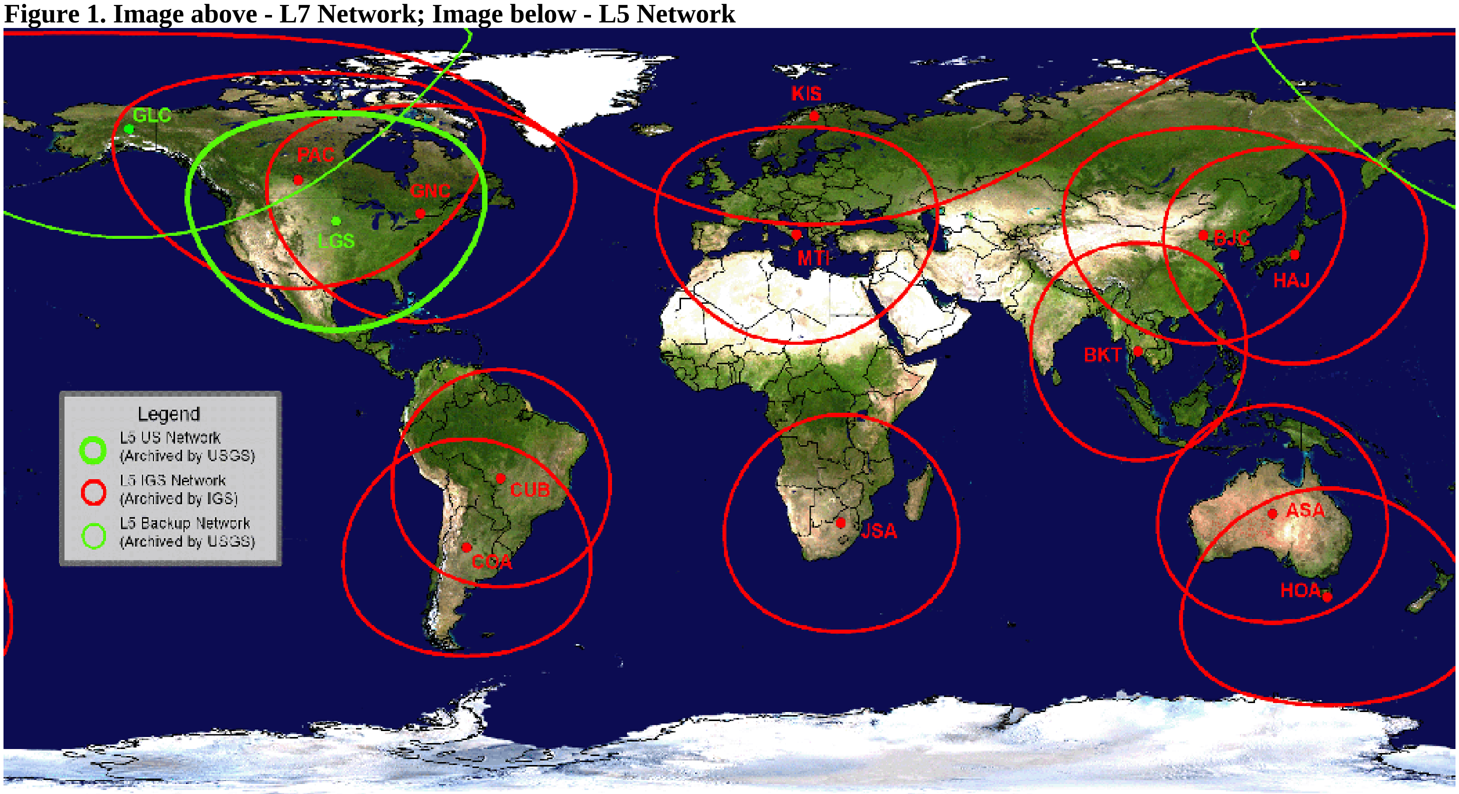


Figure 1. Image above - L7 Network; Image below - L5 Network



The table below provides a list of the International Ground Stations (IGSs) currently collecting Landsat data (as of March 2006).

International Cooperator	Ground Station Location	Ground Station ID	Landsat 5	Landsat 7
Argentina	Córdoba, Argentina	COA	x	x
Australia	Alice Springs, Australia	ASA, ASN	x	x
Australia	Hobart, Australia	HOA	x	x
Brazil	Cuíaba, Brazil	CUB	x	
Canada	Gatineau, Canada	GNC	x	
Canada	Prince Albert, Canada	PAC	x	
China	Beijing, China	BJC	x	
European Space Agency	Matera, Italy	MTI	x	
Indonesia	Parepare, Indonesia	DKI		x
Japan	Hatoyama, Japan	HAJ	x	
Japan	Hiroshima, Japan	HIJ		x
South Africa	Hartebeesthoek, South Africa	JSA	x	
Sweden	Kiruna, Sweden	KIS	x	
Thailand	Bangkok, Thailand	BKT	x	

Landsat Updates - Volume 1, Issue 2, 2007

Landsat Science Team Spotlight

To address the science goals of the Landsat Data Continuity Mission (LDCM), the Landsat Science Team has been selected to investigate and advise the U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA) on issues critical to the success of this endeavor. With that in mind, we would like to take the opportunity to introduce you to some of these people.

Mike Wulder and Joanne White
Pacific Forestry Centre – Canadian Forest Service

Mike Wulder
Research Scientist, Forest Inventory and Analysis

<u>Background/Education</u>
B.S. (Honours – geography), 1995, University of Calgary; M.E.S. (environmental studies), 1996, University of Waterloo; Ph.D. (remote sensing), 1998, University of Waterloo

<u>Primary Focus</u>
- Studies optical and light detection and ranging (LIDAR) remote sensing (laser altimetry), geographical information systems (GIS), spatial statistics, and change detection

- Estimates forest inventory and structural parameters

Projects

- Canada's National Forest Inventory and Earth Observation for Sustainable Development (EOSD):

  - EOSD Project Summary
    - http://www.fao.org/DOCREP/ARTICLE/WFC/XII/0639-B1.HTM
  - EOSD Land Cover
    - http://www.eosd.cfs.nrcan.gc.ca/cover/index_e.html

Joanne White
Spatial Analyst, Forest Inventory and Analysis, Forest Information, Landscape Management

Background/Education

B.S. (geography), 1994, University of Victoria; M.S. (geography), 1998, University of Victoria.

Primary Focus

- Conducts analysis incorporating optical remote sensing, geographic information systems, and spatial statistics

Projects

- EOSD
http://www.fao.org/DOCREP/ARTICLE/WFC/XII/0639-B1.HTM

- Mountain Pine Beetle Initiative
http://mpb.cfs.nrcan.gc.ca/index_e.html

Publications from Mike Wulder and Joanne White

- **Forest inventory height update through the integration of LIDAR data with segmented Landsat imagery** (*Can. J. Remote Sensing*, Vol. 29, No. 5, pp. 536–543, 2003)

- **An accuracy assessment framework for large-area land cover classification products derived from medium resolution satellite data** (*International Journal of Remote Sensing*, Vol. 27, No. 4, pp. 663-683, Wulder, M., S. Franklin, J. White, J. Linke, and S. Magnussen, 2006)

- **Validation of a large-area land cover product using purpose-acquired airborne video** (*Remote Sensing of Environment*, Vol. 106, No. 4, pp. 480-491, Wulder, M., J. White, S. Magnussen, and S. McDonald, 2007)

These and many more publications can be accessed through the Canadian Forest Service Bookstore:
http://bookstore.cfs.nrcan.gc.ca/searchpubs_e.php?AuthorIDs=AU11091

Happy 35th Anniversary!

On July 23, 2007, the Landsat Program celebrated the 35th anniversary of the launch of its first satellite, ERTS-1 (Earth Resources Technology Satellite-1). Renamed Landsat 1 in 1975, it was followed by two very similar satellites: Landsat 2, launched on January 22, 1975, and Landsat 3, launched on March 5, 1978. The legacy continues today with Landsats 5 and 7, two operational satellites that augment a global archive that is maintained at the U.S. Geological Survey's Center for Earth Resources Observation and Science (EROS). The Landsat Data Continuity Mission is currently developing a new satellite with a planned launch date of 2011.

This 35-year legacy of land imaging reveals how land changes over time, whether caused by forces of nature or humans. USGS scientists can estimate timber removal from the Amazon rainforest, monitor regrowth after wildfires or volcanic eruptions, document the expansion of our world's largest cities, or evaluate how policies affect changes in agriculture. The Landsat project is a key tool for understanding our changing world.

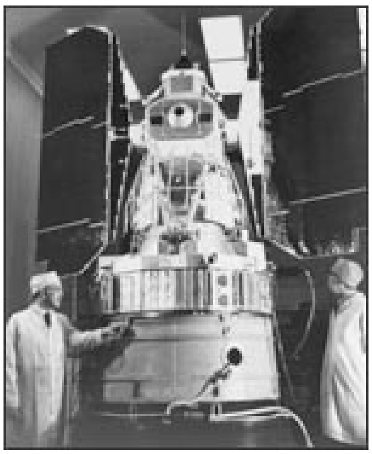


Figure 1. Landsat 1 in the assembly room

Landsat—Protecting the Price of Bread

By Laura Rocchio
Reprinted from *NASA GoddardView*, Volume 3, Issue 7, May 2007
www.nasa.gov

Year-to-year we expect the price of bread to remain relatively stable, but rarely do we realize the complex interactions and activities that are responsible for that price stability. And even less often do we realize that Landsat satellite data are behind the accurate global crop production estimates that enable such price stability.

Stable food prices are the result of a delicate balance between food supply and demand. To drastically simplify: if agricultural supply is too high, prices fall to a level where farmers cannot afford to plant; if supply is too small, food prices can soar. So, an unstable agricultural commodities market can lead to wild food price fluctuations—much like the gas price fluctuations caused by recent oil market swings.

To read the full story, visit http://www.nasa.gov/centers/goddard/news/gnews_detail.html and click on the Volume 3, Issue 7 link.

LTWG-16 Meeting Held in Brazil

May 14 • The 16th Landsat Technical Working Group (LTWG) meeting was held in Brazil May 14–18, 2007. The meeting was organized by USGS and hosted by the Instituto Nacional de Pesquisas Espaciais (INPE) in São José dos Campos, Brazil. International Cooperator representatives from nine countries and members of the USGS Landsat project and NASA Landsat Science Office discussed topics of technical interest, including the status of LDCM, Landsat 5 and 7 operational issues, the Mid-Decadal Global Land Survey (MDGLS), results from a geometric accuracy analysis of the tri-decadal survey, data validation and exchange, redefinition of the metadata format, and Landsat Science Team activities. Each International Cooperator presented a station report, including the status of their historical archive. The Japan delegation briefed the group on the status of the Advanced Land Observing Satellite (ALOS) mission. INPE hosted visits at two of their facilities located in São José dos Campos and Cachoeira Paulista, including a tour of the Center for Weather Forecast and Climate Studies. INPE also briefed the group on the China Brazil Earth Resources Satellite (CBERS) program and the processing system that handles CBERS and Landsat data.

Meeting Actions

USGS took actions to assist the International Cooperators in updating their data processing software to accommodate changes in the Enhanced Thematic Mapper Plus (ETM+) and Thematic Mapper (TM) telemetry. The USGS will also continue efforts to keep the International Cooperators current on the status of LDCM. Finally, initial steps were taken to catalog the capabilities of the stations to read older media formats, with an eye toward archive preservation and recovery from deteriorating physical media.

Contributor: Terry Arvidson

Is USGS meeting the needs of our core Landsat users?

USGS LDCM, in conjunction with the USGS Office of Budget and Performance, conducted a customer satisfaction survey to measure how satisfied Landsat users are and to identify key product characteristics and data delivery strategies. The survey was sent to non-Federal users who had purchased data from the USGS Center for Earth Resources Observation and Science (EROS). (Federal users were surveyed in a separate effort.) We received 243 viable responses, providing a response rate of 48 percent.

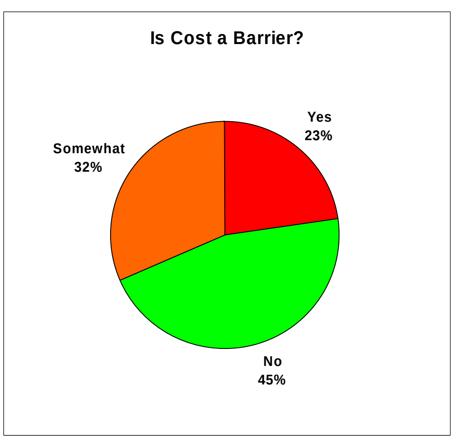
What did the survey find?

Users were asked to rate the importance and satisfaction of several things related to Landsat data. Ratings were from 1 to 5, with 1 being high and 5 low. Most of the satisfaction indicators were rated fairly high, but the factors that users rated lower in satisfaction, but higher in importance were:

1. Cost (mean importance 1.83, mean satisfaction 2.46)
2. Geometric accuracy (mean importance 1.63, mean satisfaction 2.22)
3. Geometric consistency
    a. With adjacent scenes (mean importance 1.89, mean satisfaction 2.28 and
    b. Over time (mean importance 1.8, mean satisfaction 2.38)
4. Radiometric accuracy (mean importance 1.88, mean satisfaction 2.3)
5. Geodetic datum (mean importance 1.8, mean satisfaction 2.28)

More than 55 percent of users indicated that cost is at least somewhat of a barrier, and many said why, including:

- Funding for data purchases is limited for:
    - Educational institutions
    - Small businesses
    - Small non-governmental organizations (NGOs)
    - Nonprofit organizations
    - Developing countries
    - Local, regional, and state government
- Some would use it for potential new business, but pass because of the cost.
- For larger areas (especially at a national scale or higher), the cost is prohibitive.
- For cloudy areas, they would like to buy more scenes to make cloud-free composite images.
- It is difficult to afford enough images to do a time-series analysis.
- For industry, the higher the cost, the harder it is to justify to the client—or it may impact the scope of the study.



What are we doing to improve?

Cost: USGS is moving toward "Web enabling" or downloading Landsat data. A pilot study began on June 4 to "Web-enable" Landsat 7 terrain corrected data over the United States—this is the first step toward what will be standard practice in the LDCM era.

The approach LDCM is planning at the moment is to deliver the LDCM "standard" product in the preferred projection (UTM), datum (WGS84), and format (GeoTIFF) with a goal of web enabled download via File Transfer Protocol (FTP). The results of this survey seem to confirm that this approach will meet the bulk of the Landsat data users' needs and will reduce the barriers that the current cost of the data imposes on small business, educational and nonprofit institutions, large-scale studies, and exploratory analyses.

Much more information from this survey is available. You are welcome to contact Ann Krause at akrause@usgs.gov for more survey results, or to provide your own thoughts.

Did you know?

The USGS Landsat project provides links to many educational sites!

Landsat's Educational page: http://landsat.usgs.gov/links/educational_links.php

Landsat's education and outreach program has spawned many educational resources. To enable educators' seamless access to all of these resources, Landsat and LDCM education are united into one program. Their goal is to enable you to access and use the entire Landsat Program's data, imagery, and associated science content for your own purposes.

We hope you enjoy exploring these myriad free educational and interpretive resources, images, classroom activities, modules, tutorials, and more.

Landsat Educational Links:

1. http://landsat.gsfc.nasa.gov/education/compositor/
2. http://ccrs.nrcan.gc.ca/resource/tutor/fundam/index_e.php
3. http://rst.gsfc.nasa.gov/
4. http://landsat.gsfc.nasa.gov/education/teacherkit/
5. http://www.nasa.gov/audience/forkids/home/index.html
6. http://remotesensing.usgs.gov/education.php
7. http://ldcm.gsfc.nasa.gov/outreach.html
8. http://landsat.gsfc.nasa.gov/education/activity_matrix.html
9. http://craters.gsfc.nasa.gov/index.htm
10. http://www.earthfromspace.si.edu/default.asp

Conferences

International Geoscience and Remote Sensing Symposium (IGARSS)

July 23–27, 2007, Barcelona, Spain

Link to the IGARSS homepage:

http://www.igarss07.org/frontal/Inicio.asp

Ecological Society of America (ESA)

August 5–10, 2007, San Jose, California

Link to the ESA annual meeting homepage:

http://esa.org/sanjose/

Trip Report

Landsat personnel recently participated in the Association of American Geographers (AAG) and the American Society for Photogrammetry and Remote Sensing (ASPRS) conferences. AAG was held in San Francisco, California, April 17–21, 2007. There were more than 5,000 registered attendees and more than 3,000 individual sessions. Landsat helped support the USGS booth. ASPRS was held in Tampa, Florida, May 7–11, 2007. There were approximately 1,500 attendees and 77 exhibit booths. The Landsat project collaborated with the Commercial Data Acquisition and Management (CDAM) project to staff an exhibit booth.

The Landsat project just returned from the International Symposium on Remote Sensing of Environment (ISRSE) conference.

June 25–29, 2007, San José, Costa Rica

Landsat Project Booth 4

Link to the ISRSE homepage:

http://www.cenat.ac.cr/simposio/index.htm

Landsat Image

Three Gorges Dam in China

When completed, the $25 billion Three Gorges Dam on the Yangtze River will be the largest hydroelectric dam in the world, more than five times the size of the Hoover Dam in the United States. Spanning more than two kilometers (km) across and 185 meters (m) above the world's third longest river, its reservoir will stretch more than 600 km upstream.

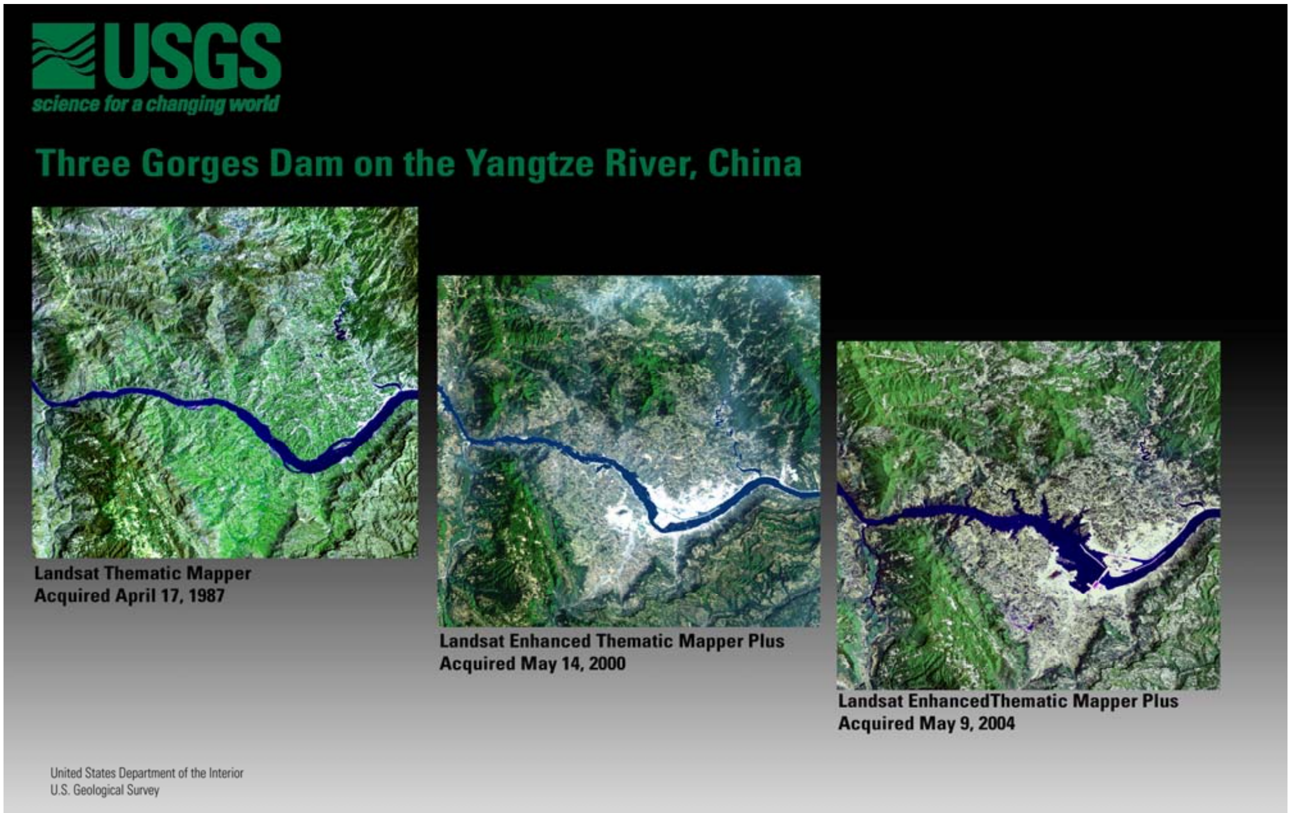
Construction began in 1994, with the dam itself completed in May 2006. Several generators still have to be installed, and the dam is not expected to become fully operational until approximately 2013.

Although there are economic benefits from flood control and hydroelectric power, the project has been plagued by massive corruption problems, spiraling costs, technological problems, human rights violations, and resettlement difficulties.

In addition, there is concern about the displacement of residents; as of 2006 nearly one million people had lost their homes. Many are living under poor conditions with no recourse to address outstanding problems with compensation or resettlement. It is estimated that more than two million people will be displaced by the time of completion.

The loss of many valuable archaeological and cultural sites, as well as the effects on the environment, is also plaguing the project. It is believed that the dam is a contributing factor in the extinction of the Yangtze River dolphin.

The dam is located at a latitude of 30.83° North and a longitude of 111.01° East (30.827778° N 111.009167° E).



Landsat Information

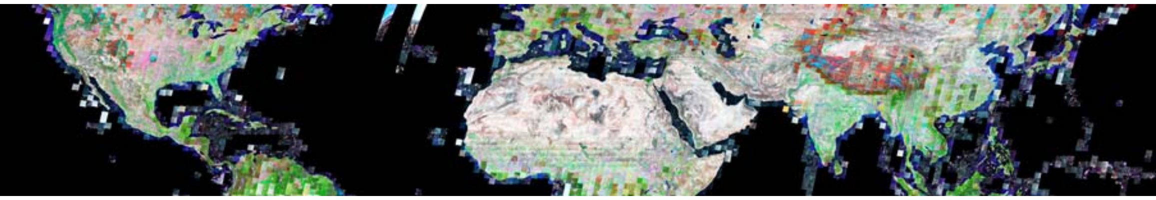
USGS Ground Stations

Sites in both South Dakota and Australia capture data from the Landsat satellites. The Landsat Ground Station (LGS) is located at the USGS EROS in Sioux Falls, South Dakota. The Alice Springs (ASN) site is located at the ACRES facility (http://www.ga.gov.au/acres/) in Alice Springs, Australia. These sites receive both science data (via X-band Radio Frequency [RF] link) and spacecraft health and safety data (via S-band RF link). LGS also provides tracking services and a command link to the spacecrafts. LGS and ASN send all S-band data to the Mission Operations Center (MOC) in real-time for immediate health and safety monitoring. Science data collected at ASN are sent to EROS where the Landsat 7 Processing System (LPS) or the Landsat Archive Conversion System (LACS) processes either the Landsat 7 or Landsat 5 data, respectively. The NASA Tracking Data and Relay Satellite System (TDRSS) (http://msl.jpo.nasa.gov/Programs/tdrss.html) is also used to provide S-band support for Landsat 7.

Ground sites in Poker Flat, Alaska (DataLynx), and Svalbard, Norway (SGS), are used as backup sites during times when extra ground resources are necessary to fulfill mission objectives.

The LGS has one main 10 meter antennae for both X-band and S-band and a 5.4 meter antennae for backup, when necessary. The 10 meter antennae downlinks two X-band frequencies so the LGS can downlink international data stored onboard the spacecraft and live data as it passes over the U.S. This capability is not needed for Landsat 5 as it does not have onboard storage. To see live passes over the United States, go to EarthNow!.
http://earthnow.usgs.gov

In the next Landsat Update: a look at the International Ground Station (IGS) Network



USGS
science for a changing world

Landsat Updates - Volume 1, Issue 1, 2007

Landsat Science Team Meeting held January 9-11, 2007

Members of the newly-formed Landsat Science Team held their inaugural meeting at the U.S. Geological Survey (USGS) Center for Earth Resources Observation and Science (EROS) on January 9-11, 2007.

USGS project scientist Tom Loveland and NASA project scientist Jim Irons led the meeting. Their responsibilities will include facilitating the functions of the team and setting the team's agenda and priorities. Dr. Curtis Woodcock of Boston University was elected to serve as the Team Leader. His responsibilities include serving as the lead representative of the Landsat Science Team, acting as a spokesperson for the team, and communicating team needs to the USGS and NASA.

Also established were four working groups that will each work with USGS and NASA staff to address a set of Landsat program and LDCM mission topics:

- Operations Acquisition strategy – GMAP, International Cooperators, Off-Nadir Acquisition Issues (led by Darrel Williams, NASA)
- Products – Archive Data, Data Gap and Mid-Decadal Studies, Quality Assurance and Validation, User Models, Application Development, Data and Measurement Continuity, (led by John Dwyer, SAIC/USGS; Jeff Masek, NASA)
- Future Missions, Outreach, and Advocacy – Long-term Observation Needs, International Cooperation, Thermal Band (led by Sam Goward, University of Maryland)
- Instrument Engineering – Calibration, Observation Technologies, Surface Reflectance, Atmospheric Corrections, Thermal Infrared Imaging (led by Dennis Helder, South Dakota State University)

Specific topics were identified for study prior to the next meeting. These topics are related to mission operations, the future of land imaging, the USGS Landsat data distribution, data gap mitigation implementation, and international cooperator historical holdings.

In addition, a letter advocating an LDCM thermal infrared imaging sensor was drafted by the team, to be sent to key officials in NASA, USGS, and other organizations.

The inaugural meeting ended by planning future meetings, which will be semi-annual. Meeting location will tentatively rotate among USGS, NASA, and Science Team member facilities. The next meeting will be held during the summer of 2007 in Corvallis, Oregon and will be hosted by Warren Cohen of the Forest Service.

U.S. Department of the Interior
U.S. Geological Survey

Landsat in Everyday Places

In 2006, Landsat scenes could be sighted in books, magazines, on TV, and in the movies. One of our most visible locations is in the Smithsonian National Air and Space Museum, where Landsat scenes make up part of a traveling exhibit entitled "Earth from Space."

In 2007, a pair of Landsat scenes was published in National Geographic Magazine in a February, 2007 story on mangrove forests (http://www7.nationalgeographic.com/ngm/0702/feature5/index.html). The Landsat scenes showed the impact of aquaculture on this increasingly threatened ecosystem on the west coast of Honduras, and were adapted from "One Planet, Many People: Atlas of Our changing Environment," published by the United Nations Environment Programme in 2005. A detailed description can be found in Chapter 3.2 on pages 98-99 of the atlas (http://na.unep.net/OnePlanetManyPeople/chapters.html).

USGS Acquisition Strategy for Ground System Segments

The National Aeronautics and Space Administration (NASA) and the Department of the Interior's U.S. Geological Survey (USGS) share responsibility for the Landsat Data Continuity Mission (LDCM). NASA will procure and/or develop the satellite and instrument, provide launch services, and perform on-orbit satellite checkout. The USGS will develop and implement the ground station network, including archive and image processing facilities, and will conduct satellite operations, data archiving, and product dissemination. In addition, the USGS will be responsible for satellite flight operations. View the entire document

LDCM Operational Land Imager (OLI) Proposals in Review

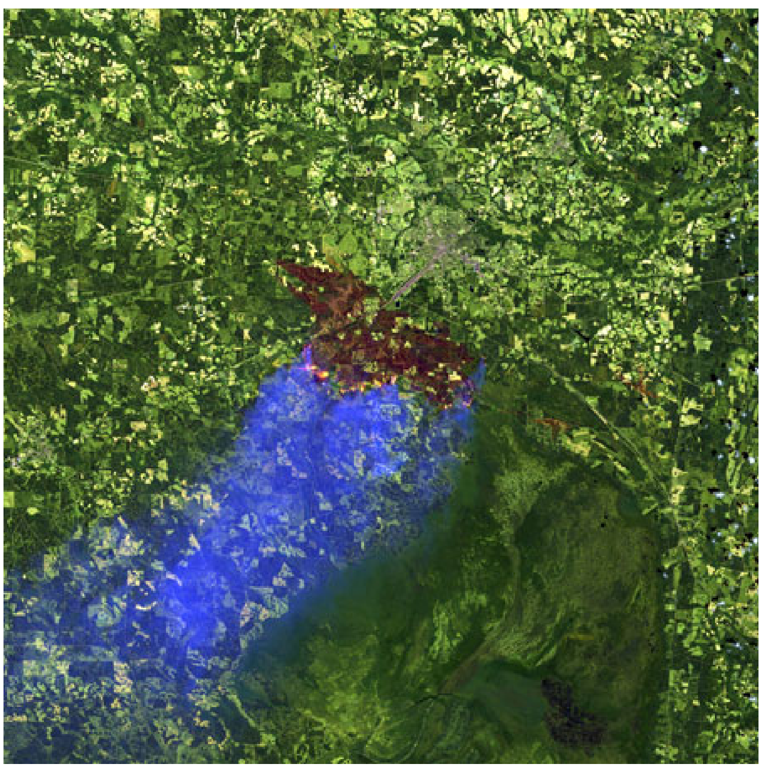
The LDCM Operational Land Imager (OLI) Requests for Proposals (RFP) were received by February 23, 2007. Proposals are currently being reviewed. NASA plans to award the contract in early summer 2007.

Image Spotlight

"Georgia Fires"

http://landsat.usgs.gov/gallery/detail/449/

The Georgia Fires consists of two fires, the Sweat Farm Road fire and the Big Turnaround fire. The fires are located 10 miles west of Waycross, Georgia and are separated by Swamp Road. The Sweat Farm fire began on April 16, 2007, and has burned more than 87 square miles of forest and swampland in southeast Georgia. Eighteen homes were destroyed, and close to 1,000 people near Waycross, Georgia were forced to evacuate. The Sweat Farm Road fire was cause by a downed power line that ignited trees near Okefenokee National Wildlife Refuge. The Big Turnaround fire has consumed over 26,000 acres but no structures have been lost. Smoke from the fires has drifted as far south as St. Augustine, Florida and the Gulf of Mexico.



The image was acquired by the Landsat 5 Thematic Mapper (TM) on April 19, 2007.

Landsat 5 Radiometric Calibration

Effective April 2, 2007, updates to the radiometric calibration of Landsat 5 (L5) Thematic Mapper (TM) data processed and distributed by the U.S. Geological Survey (USGS) Center for Earth Resources Observation and Science (EROS) will be available. The full implementation of these processing changes will lead to an improved Landsat 5 TM data product that will be more comparable to Landsat 7 Enhanced Thematic Mapper Plus (ETM+) radiometry, and will provide the basis for continued long-term studies of the Earth's land surfaces.

Although this calibration update applies to all archived and future L5 TM data, the principal improvements in the calibration are for data acquired during the first eight years of the mission (1984 – 1991), where the change in the instrument gain values is as much as 15 percent. Additionally, the radiometric scaling coefficients for Bands 1 and 2 have also been changed for approximately the first eight years of the mission. Users will need to apply these new coefficients to convert the calibrated data product digital numbers to radiance. The scaling coefficients for the other bands have not changed.

The lifetime gain model that was implemented on May 5, 2003 for the reflective bands (1 – 5, 7) will be replaced by a new lifetime radiometric calibration curve derived from the instrument's response to pseudo-invariant desert sites and from cross-calibration with Landsat 7 ETM+. Along with the revised reflective band radiometric calibration, an instrument offset correction of 0.092 W/ (m2 sr µm) or about 0.68 K (at 300K) will also be added to all L5 TM thermal band (Band 6) data acquired since April 1999. For detailed information and background on the reasons for the change, see the Revised Landsat 5 Thematic Mapper Radiometric Calibration (2007) – PDF (300 KB)

Conferences

International Symposium on Remote Sensing of Environment (ISRSE)

June 25 – 29, 2007, San José, Costa Rica

Landsat Project Booth #4

Link to the ISRSE homepage

http://www.cenat.ac.cr/simposio/index.htm

International Geoscience and Remote Sensing Symposium (IGARSS)

July 23 – 27, 2007, Barcelona, Spain

Link to the IGARSS homepage

http://www.igarss07.org/frontal/Inicio.asp

Did You Know…?

Did you know that some Landsat Data is available for Web-enabled download?

Selected MSS, TM, and ETM+ scenes (Landsats 1-7) created for global land use and land cover research can be downloaded directly from the USGS Global Visualization Viewer (GloVis) or Earth Explorer (EE) from the Tri-Decadal Global Landsat Orthorectified single scene and Multi-Resolution Land Characterization (MRLC) datasets.

<u>GloVis</u>

1. Access GloVis: http://glovis.usgs.gov/
2. Define your spatial coverage by clicking on the map or entering the coordinates for the area of interest.
3. Select Sensor in the toolbar. You can then select MRLC → MRLC 2001 TC or Tri-Decadal.
4. Scroll through the available scenes and select the one that works best for you.
5. Click the "Add" tab at the bottom left of the page to add the selected scene (this will then be highlighted green on the map.)
6. Click the "Download" tab in the Scene List to download the selected scene.
7. Save the .tar file to a folder or directory and proceed to untar and unzip the files.
8. You can then open the files into your choice of image processing software.

<u>Earth Explorer</u>

1. Access Earth Explorer: http://earthexplorer.usgs.gov/
2. Enter the site as a Guest or as a Registered User.
3. Define your area of interest in the Spatial Coverage box.
4. Select Satellite Imagery in the Data Set Selection box and choose the sensor(s) with the download  icon
5. Define any other parameters or search restrictions and click "Search" tab.
6. When search is complete, select the scene you wish to download from the Results Summary listing.
7. Click "Start Download" and save the .tar file to a folder or directory and untar and unzip the files.
8. Then import the files into your choice of image processing software.

For more information on Web-enabled data, please access http://eros.usgs.gov/products/satellite.html.

Landsat History

Landsat…Working Beyond Expectations

When satellites are launched into orbit, expectations for a specific design life (or how long it is expected to operate) are established. All Landsat satellites (1 – 5, 7) have exceeded their design life.

Landsat 1 – 4 had a design life that exceeded expectations by an average of five years. While impressive, this statistic seems less than noteworthy when compared to Landsat 5. Orbiting the Earth since 1984, Landsat 5 continues to acquire data. Landsat 5 recently achieved 120,000 orbits, and we celebrated its 23rd birthday on March 1.

Landsat 5's success was followed by the failure of Landsat 6, which did not achieve orbit after launch in 1993. Landsat 7 was launched into orbit in 1999. Although the Scan Line Corrector failed in 2003, Landsat 7 continues its global mission and accounts for nearly all international data distribution.

2007 Landsat Updates

LDCM Instrument RFP 2007

LDCM Instrument RFP

The Request for Proposal (RFP) NNG07177439R for the Operational Land Imager (OLI) Instrument for the Landsat Data Continuity Mission was released by NASA on 9 January 2007 and can be found at http://prod.nais.nasa.gov/cgi-bin/eps/sol.cgi?acqid=122610.

The LDCM website has details about mission history, status, and further updates.
http://ldcm.usgs.gov/LDCMHome.html

Landsat 5 TM radiometry 2007

Landsat 5 TM radiometry

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Although this calibration update applies to all archived and future L5 TM data, the principal improvements in the calibration are for data acquired during the first eight years of the mission (1984-1991), where the change in the instrument gain values is as much as 15 percent. Additionally, the radiometric scaling coefficients for Bands 1 and 2 have also been changed for approximately the first eight years of the mission. Users will need to apply these new coefficients to convert the calibrated data product digital numbers to radiance. The scaling coefficients for the other bands have not changed.

The lifetime gain model that was implemented on May 5, 2003 for the reflective bands (1-5, 7) will be replaced by a new lifetime radiometric calibration curve derived from the instrument's response to pseudo-invariant desert sites and from cross-calibration with Landsat 7 ETM+. Along with the revised reflective band radiometric calibration, an instrument offset correction of 0.092 W/ (m2 sr µm) or about 0.68 K (at 300 K) will also be added to all L5 TM thermal band (Band 6) data acquired since April 1999. For detailed information and background on the reasons for this change, see the Revised Landsat 5 Thematic Mapper Radiometric Calibration (2007) - PDF (300 KB)

Landsat 7 Transition to Bumper Mode 2007

Landsat 7 Transition to Bumper Mode

On April 1, 2007, the Landsat 7 mission will begin imaging in an alternate mirror-scanning control mode from the original Scan Angle Monitor (SAM) process that has been used since the satellite was launched in 1999. This change, known as Bumper Mode, is necessary due to a predictable physical wear of the mirror bumpers mounted within the Enhanced Thematic Mapper Plus (ETM+) imaging system. Landsat 7 data users should notice little or no change as a result of this transition. Five years ago, the Landsat 5 Thematic Mapper (TM) scanner was successfully converted to this alternate imaging mode, and customers have reported no problems related to that change.

USGS Defines Roles for New Satellite Mission 2007

USGS Defines Roles for New Satellite Mission

Scientists and engineers from the Department of the Interior's U.S. Geological Survey (USGS) and NASA are moving forward in planning a successor to the Landsat 7 satellite mission. With the Landsat Data Continuity Mission (LDCM) satellite expected to launch in 2011, the two agencies have announced their roles and responsibilities in mission development, subsystems procurement, and on-orbit operations.

NASA and USGS share responsibility for the LDCM. NASA will procure and/or develop the space segment, consisting of the satellite, instrument, and launch services and will also perform on-orbit satellite checkout. The USGS will develop and implement the ground segment, consisting of the ground receiving station network, a satellite operations facility, and archive and image processing facilities. After launch and check-out, NASA will transfer the satellite to the USGS to perform flight operations, image-data capture and archiving, and product dissemination.

The USGS will use NASA procurement services to acquire mission operations software for commanding the satellite and instrument, thus ensuring compatibility with NASA's space segment procurement. The USGS will competitively procure ground segment resources, including the primary ground receiving station at the USGS EROS Center near Sioux Falls, South Dakota, as well as supplemental capabilities to ensure comprehensive and timely global data acquisition. The data-collection planning capability will be modeled after the successful Landsat 7 Long-Term Acquisition Plan to collect global land image data and will be developed through the USGS EROS Technical Support Services Contract. The mission operations facility will be configured at the USGS EROS Center through commercial facility modification contracts. The flight operations team will also be procured competitively, similar to the approach employed for the Landsat 5 and 7 missions.

Data archive and user portal capabilities will be procured competitively, while image processing functionality will be developed through the USGS EROS Technical Support Services Contract. Independent ground systems architecture analysis and integration will be led by the USGS and supported by Federally-Funded Research and Development Center resources. Finally, overall system integration into the existing USGS infrastructure will be ensured through the USGS EROS Technical Support Services Contract.

Further details regarding the USGS LDCM acquisition strategy can be found at http://ldcm.usgs.gov/.

June 4 2007

USGS Pilot Project Makes High-Quality Landsat Data Available Through Web

As of June 4, 2007, the USGS will be releasing selected Landsat 7 image data of the United States through the Web (glovis.usgs.gov or earthexplorer.usgs.gov). These data are of high quality with limited cloud cover.

This Web-enabled distribution of new and recently acquired data is a pilot project for the Landsat Data Continuity Mission (LDCM), currently projected for launch in 2011. The project will allow the Landsat data user community to help refine the distribution system planned for the upcoming LDCM. Each scene will be registered to the terrain, or "ortho-rectified," prior to being placed on the Web. Copies of these data will also be available on CD or DVD at the cost of reproduction.

Landsat data have proven useful for a wide range of applications. From disaster monitoring after Hurricane Katrina and the Indonesian tsunami to global crop condition analysis, Landsat data are being used by scientists around the world. The Web-based distribution system will allow the user community easier access to Landsat 7 data.

The pilot project will be carefully examined. Customer response will be evaluated and their insight will influence the future distribution system.

LDCM announces OLI Instrument Developer 2007

LDCM announces OLI Instrument Developer

July 16 - Ball Aerospace and Technologies Corp. of Boulder, Colo. was selected to develop the Operational Land Imager instrument for the Landsat Data Continuity Mission (LDCM). The LDCM is the successor to Landsat 7 and is scheduled for launch in July 2011.

NASA's Goddard Space Flight Center, Greenbelt, Md. will manage the LDCM development in partnership with the U.S. Geological Survey (USGS). The USGS will be responsible for LDCM operations after launch and on-orbit checkout. For more information, visit http://ldcm.nasa.gov/07-16-2007.html

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TerraLook 2007

USGS and NASA Release TerraLook Data Product

The U.S. Geological Survey (USGS), in cooperation with the National Aeronautics and Space Administration (NASA), is pleased to announce the release of the TerraLook data product. A TerraLook product is a user-specified collection of JPEG images created from Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) images from the NASA Land Processes Distributed Active Archive Center, and Tri-Decadal Global Landsat Orthorectified images from the USGS archive.

TerraLook will serve GIS, natural resource management, education, and other communities, and provide easily accessible remotely-sensed data. TerraLook images are designed for visual interpretation and display, and are of value to anyone who wants to see the changes to the Earth's surface over the last 30 years.

See the full press release and graphics at

http://www.usgs.gov/newsroom/article.asp?ID=1711

Landsat 5 made its 125000th orbit of the Earth 2007

Landsat 5 made its 125000th orbit of the Earth

On September 1, 2007, Landsat 5 made its 125,000th orbit of the Earth. Designed to complete only 16,000 orbits, the spacecraft continues to deliver images of our ever-changing planet daily. Through domestic and international ground stations, much of the Earth is imaged by the Thematic Mapper (TM) instrument, the operational imaging sensor aboard Landsat 5.

The satellite has experienced major failures with aging components. One of four reaction wheels, one of three batteries, one of two star trackers, and two of two solar array drives have all been deemed unusable. While the solar array cannot rotate due to the failed drive, the solar array, itself, continues to charge the onboard batteries. Innovative changes to daily operations have allowed the mission to survive and continue to downlink scenes around the world.

Landsat 5 experienced an issue 2007

Landsat 5 experienced an issue with its onboard batteries

Landsat 5 Status – October 25, 2007

Landsat 5 has been collecting global data sets continuously since it was launched in March 1984. The satellite has had a series of anomalies and has lost redundancy in onboard systems, but continues to collect high-quality data.

Early Saturday, October 6, 2007, the Landsat 5 Flight Operations Team (FOT) noted that battery #2 was automatically taken off-line the previous evening. All imaging was stopped in order to conserve power. Landsat 5 has three 22-cell

Nickel Cadmium batteries. During the non-sunlit part of each orbit, the batteries provide power to sustain the satellite's electrical needs. During the day-lit period of the orbit, the solar array re-charges the batteries and meets the electrical demands of the satellite. Previously, on May 21, 2004, Landsat 5's battery #1 was taken offline following an anomaly. With the loss of battery #2, Landsat 5's remaining battery may have sufficient capacity to maintain the health and safety of the spacecraft and potentially continue with some level of day-lit imaging operations. Although the mission can operate with only 1 healthy battery, the potential loss of battery #2 would mean a loss in the level of redundancy.

The satellite continues to operate on battery #3, but is not collecting imagery. In this configuration, battery #3 appears to be operating normally and maintaining an adequate charge to operate the mission to required health and safety standards. Also, the FOT has uplinked a new command load that ensures health and safety of the spacecraft operating with only one battery. It is expected that the spacecraft can operate indefinitely in this configuration (barring any further complications).

Three phases to the investigation and recovery activity are underway. Each successive phase will be dependent on the outcome of the previous phase. The tentative plan includes:

Phase 1 - Maintain and ensure the continued operation of Landsat 5 utilizing only battery #3.

Phase 2 - Determine the optimum charging profile with battery #2 and battery #3 on-line. Bring battery # 2 back on-line and monitor performance. If battery #2 and battery #3 can be charged to produce sufficient power, there is a potential to operate in this configuration.

Phase 3 - Investigate bringing battery #1 back into service.

Over the last 3 weeks the FOT, with additional battery expertise from industry, has been working through these phases. The team is currently working on Phase 2 of the plan and will work with battery experts in mid-November to bring battery #2 back on-line. By the end of November, the team will have sufficient information to make a recommendation on the Landsat 5 mission concept – return to full operations or a more limited operations concept.